Table 1: West Virginia woody plant study sites (2000).
Gives transect number, name, county, site type, age (if mined), number of species found, planted or not, date visited, and brief description of site.

Diagram 1: Diagram of valley fill sampling technique.

Table 2: West Virginia spring herbaceous study sites (2000).
Gives site number, name, county, site type (engineered or not), number of species found, number of stems counted, date visited, and brief description of site.

Table 3: List of West Virginia woody species found on study transects.
The species listed were found on the 25 forest transects and 30 mined transects that were studied. Scientific and common names given.

Table 4: Woody species found on study sites ranked from most to least present.
The transects studied can be lumped into two categories- forest sites and mined sites. This table shows the differences in species composition across these two types. The species did not have to be abundant at a particular site to be counted, merely present. These numbers do not include data that were collected from contour mine sites or their associated remnant forests. Most of the species that were found on the most forest transects were found on only a few mine transects, with the exception of *Acer rubrum*, *Liriodendron tulipifera*, and *Rubus* sp., which are often found in disturbed areas.

Figure 1: Woody species richness on all study sites. Sites are ranked not in pairs, but in decreasing species richness.
Overall, there were more species present on the forested transects than on the mined transects. The woody species are just not growing in as much variety on the mined sites as in the forests. (There were a total of 25 mined transects and 23 forest transects).

Figure 2a: Frequency of occurrence (by number of transects) of woody species on 23 forest and 25 mined sites.
Forest species occurred on more transects when they were present than mine species. A few species were found on many mine transects, but most of the species were only found on a few mine sites.

Figure 2b: Frequency of occurrence (by percent of transects) of woody species on 23 forest and 25 mined sites.
This shows the same information as the previous graph, but in proportion to the total number of transects.

Figure 3a: The presence of six major forest tree species on forest and mined areas (of total 1332 forest data points and 2808 mine data points, all size classes included).
Counting individual data points, the listed species were the most abundant on the forested transects. This graph compares the abundance of these six major species on forest transects to their abundance on mine transects.

Figure 3b: Percent occurrence of six dominant forest tree species (of total 1332 forest data points and 2808 mine data points).
This illustrates the same comparison as the previous graph, but adjusts the values so they are in proportion to the total data points collected. The major species of the forests were not present in such numbers on the mines.

Table 5: Woody species found at study sites by category.
The data can also be broken down into more specific categories, to see more clearly where the species are growing. Again, these numbers are based on presence, not abundance. Remnant forests have the most different species, and mountain top removal sites seemed to have the fewest, when grouped as such. Also, this chart illustrates that some species (for example *Acer rubrum* and *Liriodendron tulipifera*) are more generalist, and are found on all the site types. Others were found only on mined areas (*Lespedeza bicolor*) or only in forests (*Acer pensylvanicum, Lindera benzoin*)

Table 6: Woody species found, ranked by abundance in forested and mined sites. (There were 33 forest transect points and 1601 mined points where no individual was found in range.)
The distribution of species can also be considered in terms of how often the species was found as the data point in the survey. Some species that are found in great number in the forests, are not found in the same abundance on the mined sites. At the same time, common woody species on the mine sites are not found as abundantly in the forests.

Figure 4a: Species abundance distribution (total data points: 1332 forest, 2808 mined).
The raw numbers of the graph 4b(see below for description).

Figure 4b. Percent species abundance based on 1332 forest points and 2808 mined points.
The forest has more species that comprise of its community- the mines have a few species that are abundant, and many that are found only a few times. (The difference in the mine plot in this second graph is due to the large number of study points on the mine on which there were no individuals to be counted.)

Figure 5a: Stem density vs. distance from forest edge. Small woody plant [1" (2.54cm) and smaller in diameter at base] densities of mined lands compared to paired forest remnants.

Figure 5b: Stem density vs. distance from forest edge. Medium woody plant [1-3" (2.54-7.62cm) diameter at base] densities of mined lands compared to paired forest remnants.

Figure 5c: Stem density vs. distance from forest edge. Large woody plant [3" (7.62cm) and larger diameter at base] densities of mined lands compared to paired forest remnants.

Figure 6a. Small size-class mean stem density vs. distance from forest edge for three Mountain-top Removal sites (ages 6, 15, 15) compared to their three remnant forests. Small woody plants are defined as 1" (2.54cm) and smaller in diameter at base.

Figure 6b. Medium size-class mean stem density vs. distance from forest edge for three Mountain-top Removal sites (ages 6, 15, 15) compared to their three remnant forests. Medium woody plants are defined as 1-3" (2.54-7.62cm) diameter at base.

Figure 6c. Large size-class mean stem density vs. distance from forest edge for three Mountain-top Removal sites (ages 6, 15, 15) compared to their three remnant forests. Large woody plants are defined as 3" (7.62cm) and larger diameter at base.

Figure 7a. Small size-class mean stem density vs. distance from forest edge for three Valley Fill sites (ages 14, 17, 19) compared to their three remnant forests. Small woody plants are defined as 1" (2.54cm) and smaller in diameter at base.

Figure 7b. Medium size-class mean stem density vs. distance from forest edge for three Valley Fill sites (ages 14, 17, 19) compared to their three remnant forests. Medium woody plants are defined as 1-3" (2.54-7.62cm) diameter at base.

Figure 7c. Large size-class mean stem density vs. distance from forest edge for three Valley Fill sites (ages 14, 17, 19) compared to their three remnant forests. Large woody plants are defined as 3" (7.62cm) and larger diameter at base.

Figure 8a. Small size-class mean stem density vs. distance from forest edge for three Backfills (ages 12, 14, 14) compared to their three remnant forests. Small woody plants are defined as 1" (2.54cm) and smaller in diameter at base.

Figure 8b. Medium size-class mean stem density vs. distance from forest edge for three Backfills (ages 12, 14, 14) compared to their three remnant forests. Medium woody plants are defined as 1-3" (2.54-7.62cm) diameter at base.

Figure 8c. Large size-class mean stem density vs. distance from forest edge for three Backfills (ages 12, 14, 14) compared to their three remnant forests. Large woody plants are defined as 3" (7.62cm) and larger diameter at base.

Figure 9a. Small size-class mean stem density vs. distance from forest edge for three Contour Mines (all age 10) compared to their three remnant forests. Small woody plants are defined as 1" (2.54cm) and smaller in diameter at base.

Figure 9b. Medium size-class mean stem density vs. distance from forest edge for three Contour Mines (all age 10) compared to their three remnant forests. Medium woody plants are defined as 1-3" (2.54-7.62cm) diameter at base.

Figure 9c. Large size-class mean stem density vs. distance from forest edge for three Contour Mines (all age 10) compared to their three remnant forests. Large woody plants are defined as 3" (7.62cm) and larger diameter at base.

Figure 10: Mean stem density, by size-class, by mine type.
We tested if mine type differed in density with an analysis of variance for each size class, and compared mean density within size-class with Bonferroni adjusted multiple comparisons. (Proc GLM in SAS/STAT version 6.12; SAS 1990). Contour mines were significantly different than all other mine types in small and medium classes.

Figure 11a: Peerless Eagle transect site. A photo of the site illustrating the three areas of the continuous, downhill transect. Taken by Amy E.K. Long, 2000.

Figure 11b: Peerless Eagle Transect: Stem density vs. distance.
This transect represents a unique case where one can compare three types of land engineering, all at the same age, and see what woody plants might naturally recruit into the site. This site was at Peerless Eagle Mine. The site age is estimated between 12 and 15 years. It is a downhill site, where the top third is mountain-top removal, middle third is a clear-cut forest remnant (apparently cut in preparation for the fill, but never filled to that height, which has since revegetated), and the bottom third is valley fill. The soil of the clear-cut was not disturbed, except for minor components during logging. Figure 11a illustrates the lack of plant recruitment into the two engineered area, whereas the natural area, of the same age, has revegetated to a high density of stems.

Figure 12: Shannon-Weiner diversity index (H). Comparison of mined lands to forest remnants. A paired t test was performed with df = 8, t (small) = 2.92, t (medium) = 3.49, t (large) = 4.13.

Figure 13a. Site age vs. mean small stem density of 30 mined sites compared to the average of 25 forest remnants. Forested sites are displayed along x-axis, age is not implied for forests by position along x axis.

Figure 13b. Site age vs. mean medium stem density of 30 mined sites compared to the average of 25 forest remnants. Forested sites are displayed along x-axis, age is not implied for forests by position along x axis.

Figure 13c. Site age vs. mean large stem density of 30 mined sites compared to the average of 25 forest remnants. Forested sites are displayed along x-axis, age is not implied for forests by position along x axis.

Figures 13a, b, and c compare mine age and mean total density per transect site. The forest transects' means are randomly distributed across the x-axis, however, this does not indicate or represent in any way the age of those forested sites.

All three figures (a,b,c) indicate that age does not matter. Densities are not increasing over time, which is what we would expect to see in the medium and large size classes. The lines for the forest were added to give the viewer a visual cue of where the average forest density is for each size class.

Table 7a: List of West Virginia herbaceous species found on transects sampled for the EIS terrestrial analysis.
It is important to consider the presence and composition of the forest herb stratum when assessing the health of the forests. Species listed were found on sites sampled from late April to early May. Nine of the fourteen sites were considered intact forests. The remaining sites were lands that were directly adjacent to a mine, railroad, or a busy vehicular road.

Table 7b: List of West Virginia spring herbaceous species observed on three Valley fills.
During the spring herb census, three mined sites were examined. This is a list of observed herbs noted by the investigating team.

Table 8: Herbaceous species found on study sites ranked from most to least present.
Herbs are excellent indicators of forest and soil health. The engineered sites are contrasted with the intact forest sites in order to determine the effects of mining activity on adjacent forests. There might not be direct physical destruction of these adjacent forest remnants, but the disturbance of high activity levels surrounding a forest remnant may disrupt the forest, starting with the herbaceous stratum.

Table 9a: Herbaceous species found at study sites, ranked from most to least abundant (number of stems counted) in engineered and intact forests.
Several of the species which are found most abundantly on the intact forest sites were not present, or present in low numbers, on the disturbed (engineered) sites. This would indicate that the disturbance is indeed affecting the forest ecosystem, and changing the community composition. Four of the top ten intact forest herbs are also in the top ten of the engineered sites. Three of the top ten, however, were not present at all on the engineered sites. This might indicate that although some of the heartier species are persisting, some more sensitive species are disappearing.

Table 9b: Herbaceous species found at study sites, ranked by percent abundance (number of stems counted) in engineered and intact forests.
This illustrates the same as the above table, but in proportion to the total number of stems counted.

Table 10: Herbaceous species found at study sites, ranked by abundance (number of stems counted) in engineered and intact sites. (Values have been standardized by multiplying engineered numbers by 11/5 to even out difference in number of sites sampled.)
By equalizing the numbers, we can see the abundance of the species from a more level starting point. (The total number of stems for the engineered and intact forests respectively are 3254 and 6669.) The totals indicate that, even when compensated for the

different number of sites studied, the density of herbaceous stems at the engineered sites was approximately half that of the intact forest sites.

Figure 14a: Mean number of spring herb species vs. distance from toe of slope, in engineered forested site and intact forested site understories. Two-way ANOVA results: treatment effect $p = 0.0001(*)$, distance effect $p = 0.0001(*)$, treatment and distance effect $p = 0.26$. The treatment (engineered or control/intact) gave significantly different results, as did distance.

Figure 14b: Number of spring herb stems counted vs. distance from toe of slope, in engineered forested site and intact forested site understories. ANOVA results: treatment effect $p = 0.0016(*)$, distance effect $p = 0.125$, treatment and distance effect $p = 0.9$. The treatment (engineered or control/intact) gave significantly different results.

Figure 14c: Estimate of biodiversity (H) for spring understory herbs, in engineered forested sites and intact forested sites. Two-way ANOVA results: treatment effect $p = 0.003(*)$, distance effect $p = 0.099$, treatment and distance effect $p = 0.368$. The treatment (engineered or control/intact) gave significantly different results.

Table 11: Soil depth and moisture recordings from ten mines and their paired remnant forest.
Holes were dug until large rock was hit, impeding further digging, or 60cm was reached. The forest soil was consistently deeper, moister, and darker in color. The mine soil consisted mostly of small rocks and solid, impenetrable rock was hit at shorter depths.

Figure 15: Microbial activity (indicated by Formazan production) in soil samples at different land types. A comparison of land treatments at individual sites. Average bars are drawn in for each land type.
Backfills did as well as the remnant forests we looked at. And MTR's were not that far behind. VF's had less than half the production as all other site types.

Table 12: Rutgers' Soil Testing Laboratory results. Macronutrients (P, K, Mg, Ca) are in pounds per acre, and micronutrients (Cu, Mn, Zn, B) are in ppm. Nutrient levels vary greatly and are more favorable for forest plant species in the native soil samples. No trends are found with age suggesting improvement in soil pH.